paper knife. This inevitably means *so many more papers left unread.*

While on the subject of referees, I should like to protest against the impatience of many secretaries, who seem to expect the poor referee to neglect his university duties at a minute's notice and to give up his whole time to preparing a report for return post.

If Mr. Basset were to start a "British Journal of Mathematics and Physics" without adopting the referee system or some equivalent, what would he do when X. Y. Z. sent him a paper disproving the existence of gravitation, when L. M. N. wrote proving that the ether consisted of jerk-backs of energy, or when P. Q. R. called men of science fools for not agreeing with his view that the sun's photosphere was composed of diatoms of electricity?

All the same, a journal of the kind suggested, if published of a convenient size, and with the pages cut, would fill a distinct want which certainly exists.

G. H. Bryan.

### Euclid's Definition of a Straight Line.

I have long thought that by the words ἐξ ἴσου, commonly translated *evenly*, Euclid means *symmetrically.* The symmetry can be tested by turning the line over; for instance, the edge of a flat ruler is straight if, when turned over, it coincides with its original position.

If a long rigid body is rotated, while two points, one in each end, retain their places, every line of particles joining the two fixed points describes a surface of revolution, which is symmetrical (in the sense intended) with respect to the two fixed points. The innermost of all such surfaces is of vanishing breadth, and is Euclid's straight line.

J. D. Everett.

11 Leopold Road, Ealing, March 29.

### Spawning of the Plaice.

With reference to the letters of Prof. Herdman and Mr. W. Wallace as to the commencement of the spawning of the plaice this season, it may be stated that in the Moray Firth plaice were found spawning in the last week of December, and that spawning is not yet completed. The time mentioned is rather earlier than usual for this district, and it is not unlikely that spawning has been accelerated by the mild winter.

T. Wemyss Fulton.

Aberdeen, March 29.

### Fossil "Rain-drops."

The preservation of impressions of rain-drops in slabs of Triassic marl has always presented some difficulty, since mud that was soft enough to receive such impressions would seem too soft to retain them.

I have to-day, at the borders of a flood plain, in a backwater of the Dorn Valley, near the Cherwell, seen exactly similar impressions in some stiff marly clay from which the flood water has lately subsided, where the surface of the tongues of clay is covered with the foot-prints of herons, rooks and smaller birds, with sun-cracks gradually widening until the clay curls into separate flakes, and the characteristic "rain-drop" pittings dispersed over the surface upon which no rain has fallen since the water subsided. This led me to seek another cause for these peculiar marks, and I soon found their origin. The film of mud over sand was in some cases still covered with about an inch of quiet water, and the decaying vegetation in the mud had given rise to innumerable bubbles that rested unbroken upon the mud bottom, like the bubbles adhering to the sides of a tumbler of soda-water. As the water very slowly leaves these bubbles some of them break, and some become coated (by surface tension, I suppose) with a thin film of mud which strengthens the dome, so that they can become larger, as they also become flatter, and sink slightly into the tenacious mud, which then contracts slightly away, so that the diameter of the circle is enlarged. When at length they disappear, they leave circular pits behind them in the half dried mud with a slightly raised ring edge, and finally, when the mud has completely dried, these shallow rounded pittings present exactly the appearance of Triassic "rain-drops" amongst the sun-cracks and foot-marks already alluded to.

I have not seen any such explanation of these "rain-drops," but it seems to remove a difficulty.

Oxford, March 19.

E. C. Spicer.

## *THE USE OF LIGHT AND OTHER RADIATIONS IN THE TREATMENT OF DISEASE.*

One of the most interesting fields of medical research at present is the investigation of the therapeutic properties of various rays, and although much has been accomplished in a few years, there is promise of a still greater future for this development of the healing art. Any advance in medical science is of the greatest moment to the general public, and cannot be too widely known, and in this respect this branch of therapeutics has had a measure of publicity which is probably unique, but which is not altogether free from harm. The discussion of purely medical details, and the description of "cures" of apparently hopeless cases in the columns of the lay Press, have unfortunately led to misconception and to terrible disappointment to many sufferers.

The fact that certain rays of light possess special physiological properties has been long known, and valuable papers on the subject were presented to the Royal Society as far back as 1872 by Downes and Blunt. But the credit of rendering the knowledge obtained by these and other observers of practical value in the treatment of disease belongs to Finsen, of Copenhagen. His first work was to show that the chemical rays of light, the violet and ultra-violet rays of the solar spectrum, have a deleterious influence upon the eruption of small-pox, and this led him to introduce the red light treatment for this disease. The patient is confined to an apartment from which the chemical rays are excluded by means of red curtains. For the treatment to be successful the curtains must be thick enough to exclude the chemical rays as completely as they are excluded by the photographer from his plates and films. In a patient under these conditions the ordinary course of the small-pox eruption is modified, the fever of the second stage is lessened, and the scarring is infinitesimal. It is not claimed that the mortality from this terrible disease is materially diminished by the light treatment, for in a certain proportion of cases there is no hope from the first, but in a large majority suffering is diminished, convalescence is easier, and disfigurement is slight.

Finsen's next work was the development of the light treatment for lupus. Lupus vulgaris is a very chronic destructive disease of the skin and mucous membranes caused by the bacillus of tubercle, the microbe which attacks and destroys the lungs in consumption. The chemical or actinic rays are here the therapeutic agents used. These rays have a definite germicidal power, and they are also capable of setting up a peculiar form of inflammation. They are the cause of sun-burns and of pigmentation of the skin from exposure to the sun's rays. In the treatment of lupus the rays of the sun, or, more conveniently in northern climates, those of a powerful electric arc light, are concentrated by means of lenses upon the diseased area. For the lenses rock-crystal must be used, because ordinary glass obstructs the passage of a considerable proportion of the rays in the ultra-violet part of the spectrum. When the sun's rays are used a light filter is employed to cut out as far as possible the heat rays at the red and yellow end of the spectrum. The light filter is a hollow lens filled with a solution of methylene blue or an ammoniated solution of the sulphate of copper. If the electric light is used the light filter is now dispensed with, as the proportion of heat rays is much less than in the rays of the sun. Even with the light filter a certain proportion of heat rays pass, and in using either the sun or the arc light it is found necessary to cool the surface under treatment. This is effected by placing in contact with the area treated an apparatus through which a current of cold water is constantly passing, and when the electric light is used by also passing the rays through a cylinder containing distilled water, which is kept cool by a water jacket, similar to that used in the Maxim gun. Another point of importance is that the area under treatment should be rendered bloodless, for the red colouring matter of the blood prevents the passage of the chemical rays to the deeper parts of the skin. This was shown by a simple little experiment of Finsen. If a piece of sensitised paper be placed behind the lobule of the ear and a powerful light be concentrated upon it, so that the rays have to pass through the ear, the paper will not be blackened at the end of some minutes; but if the ear be compressed by two glass slides, so as to render it bloodless, and the light be concentrated as before, the sensitised paper is blackened at the end of twenty seconds. In practice the apparatus which is used to cool the surface is used to compress the area under treatment, and it is held in position by an attendant. Various means have been tried to do away with this constant personal attention, but no mechanical means yet devised can replace it, for the parts treated must be kept in accurate focus.

The light is applied for an hour at a time, and six to twelve hours after treatment the part becomes red and inflamed, and a blister commonly forms. The inflamed, blistered area heals under simple dressings. It will be noticed that the effect of light is very different from that of heat. The application of intense heat to the skin causes an immediate inflammation, a burn, while the inflammatory reaction to light does not appear for some hours. As a result of the inflammation set up, and also of the specific germicidal action of the actinic rays, the bacilli in the tissue are killed, and after successive treatments the diseased area is replaced by a pale, soft, supple scar. The cosmetic results of this treatment are unequalled. The process is essentially a conservative one. All other methods of treatment, such as removal by the knife, scraping or cauterising, are destructive and tend to produce grave disfigurement, an important point, as the disease commonly attacks the face. The disadvantages are, however, serious. In the first place, the length of time required for the satisfactory treatment of even small areas is considerable. Secondly, the apparatus is expensive, and each patient requires constant skilled attention, and this is an important item in the cost. Lastly, it is often impossible to reach the disease when it involves the interior of cavities such as the nose and mouth. In some cases also of long standing, the area involved is so extensive that the method is too slow to keep pace with the spread of the disease. With early cases a cure can be completed in a few weeks, but in some instances a cure cannot be effected in less than a year or two. A large number of cases are now on record in which patients have been free from the disease for five years and upwards, and many unfortunates who were debarred from obtaining work by their disfigurement are now in regular employment.

Certain other affections of the skin of parasitic origin can also be treated successfully by Finsen's method, notably a form of baldness: and some superficial nævi have been removed.

The use of light baths has many advocates. As commonly applied, the whole body or an affected limb is subjected to the radiations from a number of incandescent electric lamps in a closed chamber. This produces local or general perspiration, and the effect is that of a Turkish or Russian vapour bath. By another method the patient is exposed to the light from powerful arc lamps, and these appear to influence nutrition by their powerful stimulation of the skin.

To Prof. Röntgen's brilliant discovery medical science owes an incalculable debt of gratitude, for not only are the Röntgen rays of the greatest value in the diagnosis of injuries and diseases of the bones, in the localisation of foreign bodies, such as needles, bullets, &c., in the tissues, and in the demonstration of calculi, and even of diseases of the lungs and great blood vessels, but they have been found to possess therapeutic properties of immense value. In the early days of X-ray work operators and patients occasionally suffered from a peculiar form of inflammation, a so-called burn, occurring days and sometimes weeks after exposure to their action. This power has been turned to practical account in treatment. Schiff and Freund, of Vienna, showed that certain cases of lupus could be cured, at any rate temporarily, by their means, and other superficial diseases of the skin have also been found to be benefited. The results are not so certain or so permanent as those achieved by Finsen's method, but in some cases, as already indicated, the latter are inapplicable.

Not long after Schiff and Freund's discovery the rays were applied to cases of rodent ulcer, a locally malignant disease, starting in the skin and often destroying deeper structures, and even bone. Rodent ulcer usually attacks the face, and its treatment by older methods was so frequently unsatisfactory that it had received the name of *noli me tangere*. It was demonstrated that the peculiar cells of the rodent growth are destroyed by the Röntgen rays, and that they are replaced by healthy scar tissue. Recurrences do happen after apparent cure by the rays, but such recurrences are as a rule easily removed by a further application. The rays are applied to the diseased tissue for ten to twenty minutes at a time. There is little or no discomfort to the patient, and in most cases improvement is at once manifest.

The success which attended the X-ray treatment of rodent ulcer led to the hope that in it would be found the cure for cancer. But there are essential differences between rodent ulcer and cancer. Rodent ulcer is peculiarly a local disease, while the characteristic of cancer is the spread of the disease to and the involvement first of the glands and then of internal organs. The Röntgen rays have an undoubted influence upon many cancerous growths. Superficial tumours have disappeared when exposed to their action, ulceration heals, and pain is relieved, but not by any means in all cases; in some, even when the growth appears to be localised, the glands and internal organs are already involved, and there is no hope of a cure by such a purely local measure. One thing is certain, and that is that where it is possible to remove a cancer by operation that procedure should be adopted in preference to ray treatment; but where operation is out of the question suffering may be relieved by the application of the rays, and possibly the cancerous development may be checked, but cure is not to be expected. Some surgeons are now applying the rays after operation, so that any outlying cancer cells which have not been removed may be destroyed. It is as yet too early to say how far such measures are likely to prove successful.

Another therapeutic application of the X-rays demands a few words. The rays have the power of removing hair, and for this purpose are used in certain diseases where the hairs are attacked by parasites. One such disease is ringworm. The difficulty in treating this and similar diseases lies in the difficulty in thorough epilation. The rays do not kill the parasites, but they remove the infected hairs, and in that way hasten a cure. If applied for a short period only, the roots of the hairs are not destroyed, and after a time the area treated is covered with new healthy hair. The removal of superfluous hair which is so often a disfigurement by the X-rays is not to be recommended, for the effect is not permanent unless the application is made for so long a time and so often as to run a risk of exciting a severe inflammation, with the possibility of causing greater disfigurement than the original hirsuties. Moreover, there are other more satisfactory means which are quite safe.

Radium is the latest addition to the therapeutic armamentarium. The romance of its discovery, the mystery of its radiations and emanation, its relation to some important scientific theories, and, above all, the possibility of its being the long desired cure of cancer, have fixed upon M. and Madame Curie's discovery the attention of the world. The element in the form of a bromide, and other compounds more or less pure, is now under trial in various diseases. Rodent ulcers and some superficial cancers react to it with very similar results to those obtained by the X-rays. There is no doubt that it is an agent of great value, but further observations are necessary to estimate its position. It can certainly be applied to disease in regions which it is now impossible to reach by the X-rays, but that its field in the treatment of cancer is limited is obvious. Its effect is local, so far as present observation has shown, and the remarks made above upon the influence of the X-rays in cancer apply equally here. Radium has to be used with great care, for it is powerful for evil as well as for good. If too long applied it causes destruction of tissue, and such destruction may take months to heal.

It will be gathered that rapid strides have been made in this field, and it would appear that we are but on the threshold of further developments. The latest discovery, the mysterious *n*-rays which are said to be produced by nervous and muscular action, does not appear to possess therapeutic importance, and whether it is likely to be of value in diagnosis is at present purely problematical.

## IMPERIAL METEOROLOGY.

SLOWLY, but still step by step, the science of meteorology progresses, and new visions are opened up which suggest bright prospects for future possibilities, but which also lay exposed the lost opportunities of the past. Like every other science, the modern methods of observation, for at any rate the chief meteorological elements, are nearly all that can be desired, but when it is required to revert to observations made more than thirty or forty years ago, how lamentably few are the records and how uncertain in many cases is their accuracy. Further, anyone who has had occasion to hunt up early series of observations of pressure, temperature, rainfall, &c., records will have been struck with the common occurrence of breaks extending here and there for one, two, three or more years. Nevertheless, it is little use crying over the past, but strenuous efforts should be made in the future to see that the needed observations should be secured.

The more the variations of weather are studied the more is the idea strongly impressed on the investigator that these variations from year to year are not mere matters of chance, but are produced by a cause originating outside the earth's atmosphere, and with little doubt from the sun, naturally the prime factor and father of all the important weather changes.

His daily apparent journey round the earth, caused by the latter's rotation, is the origin of all the diurnal changes familiar to meteorologists.

The earth's journey round the centre of our solar system is again the origin of all the other meteorological variations which pass through their phases in a year.

From year to year, however, these daily and yearly variations, although they preserve more or less their original variations as regards their lengths of period, change in amount sometimes to a very great degree, and cause one to speculate on the probable kind of weather for the following year.

The view that these changes from year to year are due to the direct or indirect action of the sun has a very great degree of probability in its favour, since we know that this highly heated body is in an active state as deduced by the numerous and varied solar phenomena that have been observed. Further, the periodicities deduced from long series of solar observations have added another link in the chain of evidence showing that the sun's heat must be constantly varying, a fact which it is necessary to prove before solar influence can be put forth as a possible source of the terrestrial changes.

It is the work of the now numerous magnificent meteorological institutions spread over the globe for each to gather into its own particular net the meteorological changes that are occurring in its own area, and by means of these facts to forecast what kind of weather may be expected either on the following day, week or month, or as far ahead as possible. Many of these institutions for several years found that their own areas were too limited in extent to give them the necessary data for the work in hand, and so entered into a mutual compact with neighbouring countries for the exchange of certain pieces of meteorological information.

The present stage of meteorological investigation has in the last few years indicated that even this mutual help of the neighbouring countries, each working for its own immediate ends, is not sufficient for a satisfactory solution of world meteorology.

Sir John Eliot, who recently retired from the Indian Meteorological Department, one of the, if not the, finest meteorological service that exists, gives his views on this subject, which should be read by all those interested in the welfare of meteorological science (*Broad Views*, March).

Dealing with the Indian area during the period 1892 to 1902, he points out how these eleven years were unique in the history of Indian meteorology, but this condition was unfortunately disastrous to India. Not only did that extensive country suffer more severely from droughts and famines than during any other similar period for a hundred years at least, but it was paralleled, "so far as we are aware, only by the seven years of famine in Egypt in Biblical history." More interesting still is it to find that the drought of 1895 to 1902 "was a more or less general meteorological feature of the whole area, including Abyssinia, East and South Africa, Persia, Baluchistan, Afghanistan, India, probably Tibet, and the greater part or whole of Australia." Such a statement will probably recall the attention of our readers to an article published in this Journal (vol. lxvii. p. 225), in which it was stated:—"Commencing with Indian pressures (as represented by Bombay), the area was gradually extended to Ceylon (Colombo), Java (Batavia), Mauritius, and finally to Australia (Perth, Adelaide and Sydney). The striking similarity between these curves shows that over the whole of this area, which includes both north and south latitudes, the same kind of variation is in action, and therefore the whole region is intimately connected meteorologically." Sir John Eliot's remarks thus indicate the truth of this result.

In the article from which the above quotation was taken it was shown that while one hemisphere of the earth, which included Europe, southern Asia, Africa, India, and Australia, was experiencing high atmospheric pressure on the average, the other hemisphere, which included North and South America and Siberia